

Current Paleontological Investigations on Cenozoic Marine Mollusks of the West Coast of North America

BY

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THIS REPORT¹ SUMMARIZES recently completed studies and work in progress on Cenozoic marine mollusks of the Pacific coast of North America. Investigations are arranged under several broad topical categories. Investigators are listed alphabetically under each category together with their institutional affiliation, if any, and current address. Many studies span more than one of these but space limitations have dictated against multiple listings. Certain non-paleontological research such as isotopic studies related to age determination or paleoclimatic analysis is included. Stratigraphic terminology is that of the individual workers. We are indebted to A. Myra Keen, N. F. Sohl, and E. C. Allison for reading, and commenting on, the manuscript.

TAXONOMY

Paleogene

CAROLE S. HICKMAN (Washington State University, Pullman, Washington 99163) has completed a master's thesis at the University of Oregon on the molluscan fauna of the Oligocene Eugene Formation of western Oregon. Mrs. Hickman is currently preparing the dissertation for publication.

SABURO KANNO (Tokyo University of Education, Tokyo, Japan) recently concluded an 11-month visit at the U. S. Geological Survey in Menlo Park, California. He is completing a taxonomic-biostratigraphic manuscript on the late Oligocene to middle Miocene molluscan faunas of the Poul Creek and Yakataga Formations of the Gulf of Alaska.

V. STANDISH MALLORY (University of Washington, Seattle, Washington 98105) is planning to have several of his recent students' theses dealing with Paleogene mollusks of western Washington rewritten for publication in a museum-based monograph and novitate series at the University.

A systematic study of Oligocene mollusks of the Pittsburg Bluff Formation of northwestern Oregon is being carried out by ELLEN J. MOORE (San Diego Museum of Natural History, San Diego, California 92112).

STANLEY R. PRIMMER recently completed a master's thesis at the University of California (Berkeley, California 94720) on the molluscan fauna of the type Kirker Formation at Mount Diablo, California. He has published a preliminary report on the biostratigraphy and correlation of the Kirker Formation.

HAROLD E. VOKES (Tulane University, New Orleans, Louisiana 70118) has completed a manuscript on the molluscan fauna of the upper Eocene and lower Oligocene Keasey Formation of northwestern Oregon.

Neogene

WARREN O. ADDICOTT (U. S. Geological Survey, Menlo Park, California 94025) has a paper in press on the taxonomy and biostratigraphy of early and middle Miocene gastropods from the southeastern portion of the San Joaquin basin, California. Included are systematic descriptions and illustrations of more than 180 early and middle Miocene gastropods.

OLUWAFEYISOLA S. ADEGOKE (Ife University, Ibadan, Nigeria) has recently published reports on first occurrences of *Swiftopecten*, *Penitella*, *Platyodon*, and *Mya* in the California Tertiary. His doctoral thesis at the University of California is now in press; it includes systematic descriptions of Neogene mollusks of the northwestern part of the San Joaquin basin, California.

EDWIN C. ALLISON (San Diego State College, San Diego, California 92115) continues his work on late Cenozoic mollusks of the eastern Pacific, including a study of Cenozoic species of *Arca*.

JOHN M. ARMENTROUT has completed a master's thesis at the University of Oregon (Eugene, Oregon 97401); this paper reviews the molluscan fauna of the type Empire Formation (Pliocene) of Coos Bay, southwestern Oregon, based on extensive collections in the Department of Geology. Included in his study is an assemblage of middle Miocene mollusks from previously unreported exposures at Coos Bay.

EUGENE V. COAN is preparing for publication his recently completed doctoral thesis at Stanford University (Stanford, California 94305) on late Cenozoic and modern Tellinacea of the northeastern Pacific and arctic Alaska.

The long awaited manuscript on Pliocene mollusks of the San Diego Formation, part of a series of reports on the Geology and Paleontology of the San Diego, California area by LEO G. HERTLEIN (California Academy of Sciences, San Francisco, California 94118) is ready to go to press. ULYSSES S. GRANT, IV (University of California, Los Angeles, California 90024) is co-author. HERTLEIN has begun work on a report on Pliocene mollusks of the Galápagos Islands.

GEORGE L. KENNEDY (San Diego Museum of Natural History, San Diego, California 92112) has completed a systematic study of fossil Pholadidae of the eastern Pacific and is preparing a manuscript for publication.

F. STEARNS MACNEIL (5958 Prather Drive, Fort Myers, Florida 33901), formerly of the U. S. Geological Survey, is continuing his

¹ Publication authorized by the Director, U. S. Geological Survey

studies on Cenozoic mollusks of Alaska. He recently published a monograph on the Cenozoic Pectinidae of Alaska.

Pliocene molluscan assemblages from the Imperial Formation near San Geronio Pass, southern California, are being studied by MICHAEL A. MURPHY and his students at the University of California (Riverside, California 92507).

RICHARD RECTOR, a student at the University of Washington (Seattle, Washington 98105), has completed a thesis dealing with mollusks of the Pliocene Quillayute Formation of the western Olympic Peninsula, Washington, and is currently rewriting it for publication.

TAKEO SUSUKI (University of California, Los Angeles, California 90024) continues his interest in middle Miocene mollusks of the type Topanga Formation, southern California.

Pleistocene

S. STILLMAN BERRY (1145 West Highland, Redlands, California 92373) is continuing his descriptive studies of Pleistocene and living warm water mollusks of the Gulf of California, western Baja California, and southern California.

WILLIAM K. EMERSON (American Museum of Natural History, New York, N. Y. 10024) is working on Pleistocene and modern mollusks of the Gulf of California and the Pacific coast of Baja California. He has several recently published reports on gastropod genera; many of these deal with the Muricidae.

GEORGE P. KANAKOFF (Los Angeles County Museum of Natural History, Los Angeles, California 90007) continues his interest in Pliocene and Pleistocene mollusks of southern California, concentrating, at the present time, on the molluscan fauna of the lower Pleistocene Lomita Marl. His collections from the Pliocene San Diego Formation have provided much of the material for LEO G. HERTLEIN's pelecypod monograph. J. ALDEN SUTHERLAND, also of the Museum, has been assisting KANAKOFF in field excavation and study of early Pleistocene mollusks from near Newport Bay, southern California. SUTHERLAND has recently begun intensive collecting of middle Miocene material from the Kern River area, central California.

JERE H. LIPPS (University of California, Davis, California 95616) has several recent publications on the Pleistocene history and foraminiferal and molluscan paleoecology of insular faunas of the Southern California Borderland; two of the reports were co-authored by JAMES W. VALENTINE of the same institution.

General

RICHARD C. ALLISON (University of Alaska, College, Alaska 99735) is studying Cenozoic Turritellidae of the eastern Pacific. He and OLUWAFEYISOLA S. ADEGOKE (Ife University, Ibadan, Nigeria) have completed a report on a new early Tertiary turritellid genus from the Pacific coast.

WILLIAM K. EMERSON (American Museum of Natural History, New York, N. Y. 10024) is continuing his studies on Cenozoic scaphopods of the Pacific coast.

A. MYRA KEEN (Stanford University, Stanford, California 94305) has written up many of the pelecypod families for the Treatise on Invertebrate Paleontology; the pelecypod volumes are now in press. She has also summarized the Archeogastropoda and several super-

families in the Mesogastropoda and Neogastropoda for the second gastropod volume of the Treatise. She has been assisted in this work by EUGENE V. COAN and other students.

CLIFFORD M. NELSON (Cabrillo College, Aptos, California 95003) has begun work on a Ph. D. dissertation on Cenozoic *Neptunea* of the eastern Pacific at the University of California, Berkeley.

WILLIS P. POPENOE (University of California, Los Angeles, California 90024) is working on opisthobranch gastropods for the Treatise on Invertebrate Paleontology. He is completing a joint study with micropaleontologist ROBERT M. KLEINFEL (University of California, Berkeley) on rates of evolution in tropical families in relation to Lyellian correlation.

GEORGE E. RADWIN (San Diego Museum of Natural History, San Diego, California 92112) is writing a monograph on the Columbellidae of the eastern Pacific. ARNOLD ROSS, of the same institution, is engaged in a systematic study of ectocommensals of Cenozoic mollusks.

ALLYN G. SMITH (California Academy of Sciences, San Francisco, California 94118) is continuing his study of fossil chitons.

JUDITH S. TERRY (Stanford University, Stanford, California 94305) is preparing a manuscript on the cymatiid genera *Argobuccinum*, *Fusitriton*, and *Priene* from her recently completed doctoral thesis. She recently published a report describing the late Tertiary genus *Mediargo*.

WENDELL P. WOODRING (U. S. National Museum, Washington, D. C. 20560) has completed the manuscript for the last part of his four-part monograph on the geology and middle Eocene to early Pliocene gastropods of the Canal Zone and adjoining parts of Panama (U. S. Geological Survey Professional Paper 306A-D).

BIOSTRATIGRAPHY

WARREN O. ADDICOTT (U. S. Geological Survey, Menlo Park, California 94025) has a manuscript in press on Pliocene molluscan faunas of the central Santa Cruz Mountains, California, and their paleogeographic significance. He is working on molluscan faunas from the upper Miocene Montesano Formation of southwestern Washington, the type Temblor Formation of central California, and lower and middle Tertiary formations of the Santa Monica Mountains, southern California.

OLUWAFEYISOLA S. ADEGOKE (Ife University, Ibadan, Nigeria) has a manuscript in press, based on his Ph. D. thesis, on the molluscan biostratigraphy of the classic Miocene and Pliocene sequences of the Coalinga and Reef Ridge sections of the western portion of the San Joaquin basin, California, originally studied by RALPH ARNOLD in 1909.

KENNETH W. CIRIACKS and ALAN R. ORMISTON (Pan American Research Laboratory, Tulsa, Oklahoma 74103) have been working on the biostratigraphy of middle and upper Tertiary molluscan faunas of the Gulf of Alaska and the Alaska Peninsula.

EUGENE A. FRITSCH (San Fernando Valley State College, Northridge, California 91326) is completing work on a Ph. D. dissertation at the University of California, Los Angeles, on the biostratigraphy and taxonomy of Miocene molluscan faunas of the Sierra Madre Mountains, southern California.

CHARLES R. GIVENS (University of Georgia, Athens, Georgia 30601) is adapting for publication his recently completed Ph. D. disserta-

tion at the University of California, Riverside, on Eocene molluscan biostratigraphy of the Transverse Ranges, California. GIVENS has published a preliminary report reaffirming the validity of the four Eocene stages (Capay, Domengine, Transition, and Tejon) proposed by B. L. CLARK and H. E. VOKES in 1936.

SABURO KANNO (Tokyo University of Education, Tokyo, Japan) is describing the middle Tertiary faunal sequence of the Gulf of Alaska based mainly on collections made during the summer of 1968 at Cape Yakataga.

FRANK H. KILMER (Humboldt State College, Arcata, California 95521) is continuing work on Neogene mollusks and associated marine vertebrates of Cedros Island, Baja California.

SCOTT MCCOY, JR. (Phillips Petroleum Corp., Bartlesville, Oklahoma 74004) is studying the Tertiary molluscan biostratigraphy and paleoecology of the Alaska Peninsula and Gulf of Alaska. He is preparing a manuscript describing a new species of *Pterynotus* from the middle Tertiary Poul Creek Formation.

ROBERT G. McWILLIAMS (Miami University, Oxford, Ohio 45056) recently completed a doctoral dissertation on Eocene and Oligocene biostratigraphy of central western Oregon including a thorough re-evaluation of older work on marine mollusk faunas. He has a manuscript in progress on mollusks of the Eocene Crescent Formation and is planning a report on mollusks of the type Twin River Formation.

C. PERCY STRONG, a University of Washington graduate student, has completed a manuscript on middle Tertiary mollusks and foraminifers from southwestern Washington.

JOHN G. VEDDER (U. S. Geological Survey, Washington, D. C. 20242) has recently published a detailed geological map of the intertonguing marine and nonmarine Tertiary section of the eastern part of the Caliente Range, California, and is now working on the molluscan biostratigraphy in collaboration with continental vertebrate and foraminiferal specialists. This study is expected to provide greatly improved standards for provincial Miocene correlation. VEDDER is extending his field investigations to the nearby portion of the Temblor Range and San Rafael Mountains. He is also completing a biostratigraphic report on late Cenozoic mollusks of the southwestern part of the Los Angeles basin, California.

DONALD W. WEAVER (University of California, Santa Barbara, California 93106) and his students are preparing a summary report on the geology and paleontology of the Channel Islands off southern California. Included will be new biostratigraphic data on Eocene and Miocene molluscan faunas.

PALEOECOLOGY

JOHN W. EVANS (Memorial University of Newfoundland, St. John's, Newfoundland, Canada) has been studying burrowing mechanisms in pholadid pelecypods, in particular *Penitella*. He has recent publications on the relationship of rock hardness to burrow shape, identification of fossil burrows, and a method for estimating rock hardness at time of burrowing.

CLARENCE A. HALL, JR. (University of California, Los Angeles, California 90024) is studying the late Miocene and Pliocene paleoecology of western San Luis Obispo County, California.

JOHN P. KERN (San Diego State College, San Diego, California 92115) has a manuscript in press on the early Pliocene molluscan paleoecology of the eastern part of the Ventura basin, southern California, based on a recently completed doctoral thesis at the University of California, Los Angeles.

ROBERT G. McWILLIAMS (Miami University, Oxford, Ohio 45056) is preparing a report on the paleoecology of late Eocene mollusks and corals from near Seattle, Washington.

V. STANDISH MALLORY (University of Washington, Seattle, Washington 98105), in cooperation with geomorphologist DONALD J. EASTERBROOK (Western Washington College, Bellingham, Washington 98225), is studying the paleoecology of late Pleistocene and Holocene marine mollusks from glacio-marine tills in northwestern Washington.

LOUIS MARINOVICH expects to complete in mid-1969 a master's thesis at the University of Southern California (Los Angeles, California 90007) on Pleistocene molluscan faunas of the higher marine terraces at Palos Verdes Hills, southern California. To date, 42 previously unreported species have been found in the higher terraces, many from new localities exposed during the continuing urbanization of the area. W. H. EASTON of the same institution is collaborating with isotope geologist JOHN K. OSMOND (Florida State University, Tallahassee, Florida 32306) on a study of radiometric ages of molluscan faunas from these terraces. MARINOVICH is also working on the paleoecology of the early Pleistocene Lomita Marl based on quantitative study of 119 species of mollusks.

ROBERT F. MEADE (California State College at Los Angeles, Los Angeles, California 90032) has completed a doctoral thesis at the University of California, Los Angeles, on the paleoecology of the Santa Barbara zone of southern California. He has published preliminary reports on the shallow water Pliocene mollusks that have been incorporated in deep water turbidites of the Fernando Formation.

GARY ROSENBERG has started a graduate research program at the University of California (Los Angeles, California 90024) on the paleoecology, distribution, and evolution of the bivalve mollusk *Chione* in California.

ROBERT W. ROWLAND has begun work on a doctoral dissertation at the University of California (Davis, California 95616) on Pleistocene mollusks of the Bering Sea. The study is being carried out in cooperation with Pleistocene geomorphologist DAVID M. HOPKINS (U. S. Geological Survey, Menlo Park, California 94025). ROWLAND recently completed a manuscript from his master's thesis on the paleoecology of the molluscan fauna of the San Diego Formation of northwestern Baja California, Mexico.

ROBERT J. STANTON, JR. (Texas A&M University, College Station, Texas 77843) has completed a paleoenvironmental study of Miocene mollusks of the Temblor and Santa Margarita Formations from the western side of the San Joaquin Basin near Coalinga, California. He has recent publications on the paleoecology of the upper Miocene Castaic Formation of the eastern portion of the Ventura basin, southern California.

ROBERT R. TALMADGE (2850 Pine Street, Eureka, California 95501) is studying the relationship of deep water mollusks from the Pliocene Rio Dell Formation of the Wildcat Group, northern California, to modern assemblages dredged off the nearby coast by trawlers.

JAMES W. VALENTINE (University of California, Davis, California 95616) is spending the 1968-1969 academic year on sabbatical leave at Oxford University, England, where he is writing a book on evolutionary paleoecology.

JOHN E. WARME (Rice University, Houston, Texas 77001) completed a Ph.D. thesis at the University of California, Los Angeles, on paleoecologic aspects of the modern ecology of Mugu Lagoon, Ventura County, California. A recent publication concerning post-mortem transport in fossil assemblages was developed from the dissertation.

BIOGEOGRAPHY

WARREN O. ADDICOTT (U. S. Geological Survey, Menlo Park, California 94025) has recently published reports on Oligocene and Miocene zoogeographic discontinuities across the San Andreas fault, California, supporting inferences of post-Oligocene cumulative right-lateral slip of as much as 190 miles. He is currently completing studies on Miocene latitudinal faunal gradients along the Pacific coast and their relation to the San Andreas fault.

A recent publication by J. WYATT DURHAM (University of California, Berkeley, California 94720) and F. STEARNS MACNEIL (5958 Prather Drive, Fort Myers, Florida 33901) summarizes molluscan evidence for late Cenozoic marine migrations through Bering Strait beginning in the late Miocene. More than 125 species of Pacific origin have entered the Arctic-Atlantic area, whereas only about 16 Pacific species seem to have had Atlantic origins.

A. MYRA KEEN (Stanford University, Stanford, California 94305) is continuing her long range study of the relation of California Miocene molluscan faunas to mollusks of the modern Panamic molluscan province of Central America. She has begun preparations for a revision of her important 1958 monograph on tropical mollusks of the eastern Pacific in cooperation with JUDITH S. TERRY.

KATHERINE V. W. PALMER (Paleontological Research Institution, Ithaca, New York 14850) reviewed Tethyan affinities of marine Eocene mollusks of North America, including the warm water *Venericardia planicosta* and *Velates perversus* groups, in a recent publication.

JAMES W. VALENTINE (University of California, Davis, California 95616) has recent publications on the evolution of marine molluscan provinces and the climatic regulation of speciation. In cooperation with CLARENCE A. HALL, Jr. (University of California, Los Angeles, California 90024), he is making a cluster analysis of late Miocene molluscan assemblages from California as a means of defining Tertiary molluscan provinces of the Pacific coast.

PALEOCLIMATOLOGY

WARREN O. ADDICOTT (U. S. Geological Survey, Menlo Park, California 94025) is studying middle and late Tertiary climatic change in the nearshore marine environment through a distributional analysis of warm water molluscan genera. He has completed a manuscript on climatic change in the marginal eastern Pacific and is

working on a detailed study of Tertiary paleoclimates of the San Joaquin basin, California.

CLARENCE A. HALL, Jr. (University of California, Los Angeles, California 90024) is studying growth layering in bivalved mollusks as an aid in paleobiogeographic interpretation of eastern Pacific molluscan faunas.

ROBERT J. STANTON, Jr. (Texas A&M University, College Station, Texas 77843) is working on a faunal and geochemical analysis of Pliocene marine climate of the northwestern San Joaquin basin, California, in cooperation with J. ROBERT DODD (Indiana University, Bloomington, Indiana 47401). A preliminary report is in press.

SYMPOSIA

Plans for a symposium volume on molluscan biogeography of the eastern Pacific are being formulated by VICTOR A. ZULLO (California Academy of Sciences, San Francisco, California 94118) and EUGENE V. COAN (Stanford University, Stanford, California 94305). Several molluscan paleontologists will be invited to contribute to this effort.

DAVID M. HOPKINS' (U. S. Geological Survey, Menlo Park, California 94025) recently published symposium on the Bering Land Bridge (1967) includes several papers containing Tertiary and Quaternary molluscan faunal data from Alaska and Chukotka, including a report by J. WYATT DURHAM and F. STEARNS MACNEIL on Cenozoic migrations through Bering Strait.

DWIGHT W. TAYLOR (Arizona State University, Tempe, Arizona 85281) is editing a review volume on malacology in western America. Contributions by molluscan paleontologists on marine ecology and taxonomy are planned.

CATALOGS, GUIDEBOOKS

WARREN O. ADDICOTT (U. S. Geological Survey, Menlo Park, California 94025) is preparing annotated bibliographies of literature on Neogene and Quaternary mollusks of the eastern Pacific Ocean and arctic Alaska.

JAMES H. McLEAN (Los Angeles County Museum of Natural History, Los Angeles, California 90007) has completed a catalog of living marine mollusks of Los Angeles County coast, California, and is working on a distributional list of modern prosobranch gastropods of the northeastern Pacific from Alaska to central Baja California.

ELLEN J. MOORE (San Diego Museum of Natural History, San Diego, California 92112) recently completed a guidebook of fossil mollusks of San Diego County, California, with illustrations of Eocene, Pliocene, and Pleistocene species.

RADIOMETRIC AGE DETERMINATIONS

Several isotope geologists are working in cooperation with paleontologists and biostratigraphers in attempting to provide radiometric age control for Cenozoic stratigraphic sections along the Pacific coast.

Late Pleistocene and Holocene radiocarbon ages based upon marine mollusks' shells have been reported by many workers during the past 10 years or so. These have been particularly useful in determining Holocene events in northwestern Washington and southwestern British Columbia, Canada.

In the past three years, uranium-series disequilibrium methods of dating mollusk shells have become increasingly useful in deciphering late Pleistocene history of the Pacific coast during the past 200 000 years. H. HERBERT VEEH (Yale University, New Haven, Connecticut 06511) and JAMES W. VALENTINE (University of California, Davis, California 95616), BARNEY J. SZABO and JOHN N. ROSHOLT (U. S. Geological Survey, Denver, Colorado 80225), WILLIAM C. BRADLEY (University of Colorado, Boulder, Colorado 80302) and WARREN O. ADDICOTT (U. S. Geological Survey, Menlo Park, California 94025), HORACE G. RICHARDS (Academy of Natural Sciences, Philadelphia, Pennsylvania 19103), and DAVID L. THURBER (Lamont Geological Laboratory, Palisades, New York 10964), F. P. FANALE and O. A. SCHAEFFER (Brookhaven National Laboratory, Upton, New York 11973) have published papers during the past three years dealing with the radiometric ages of Pleistocene terrace faunas from California and southwestern Oregon.

Potassium-argon dating of Tertiary volcanic rocks and glauconites relevant to molluscan correlation is being carried out by JOHN D. OBRADOVICH and by DONALD L. TURNER, both of the U. S. Geological Survey (Denver, Colorado 80225). OBRADOVICH has been dealing with Pliocene and Pleistocene ages as related to the Pacific coast marine chronologies; TURNER recently completed a doctoral dissertation at the University of California, Berkeley, on K-Ar dates concerning the Miocene foraminiferal chronology and has a paper in press summarizing these data. He is planning to extend his work, in collaboration with WARREN O. ADDICOTT, to include radiometric calibration of the Pacific coast molluscan sequence.

ISOTOPIC STUDIES

J. ROBERT DODD (Indiana University, Bloomington, Indiana 47401) has completed a study of oxygen isotope and strontium paleotemperatures of Pliocene and Pleistocene *Mytilus* from California. He has undertaken a joint study with ROBERT J. STANTON, Jr. (Texas A&M University, College Station, Texas 77843) of oxygen isotopic

temperatures of Pliocene mollusks from the Kettleman Hill area, central California.

CARL L. HUBBS (Scripps Institution of Oceanography, La Jolla, California 92037) is studying paleoclimatological aspects of a mixed tropical and warm temperate late Pleistocene molluscan fauna from Guadalupe Island, Mexico, by means of oxygen isotope determinations. EDWARD C. WILSON (Los Angeles County Museum of Natural History, Los Angeles, California 90007) has been studying the paleoecology of this mixed fauna.

HEINZ A. LOWENSTAM (California Institute of Technology, Pasadena, California 91109) continues his oxygen isotope paleotemperature studies on Tertiary invertebrates.

OTHER STUDIES

J. ROBERT DODD (Indiana University, Bloomington, Indiana 47401) has recently published a report on the relation of skeletal structure and shell mineralogy to growth temperature and salinity based on Pleistocene specimens of *Mytilus* from northwestern Baja California and California.

GEORGE R. CLARK II is completing a Ph. D. dissertation at California Institute of Technology (Pasadena, California 91109) on daily growth increments in the Pectinidae. His work includes paleoecologic applications in the study of late Tertiary pectinids from Baja California.

H. EDWARD CLIFTON (U. S. Geological Survey, Menlo Park, California 94025), a sedimentologist, has been investigating the preferred orientation of disarticulated valves of late Cenozoic pelecypods, particularly *Psephidia*, in the shallow water Elk River Formation of southwestern Oregon. In addition to field observation, CLIFTON has been introducing fossil shells into modern subtidal environment and monitoring settling patterns by use of self-contained underwater breathing apparatus. Similar studies, including laboratory experimentation, have been made by CORTEZ W. HOSKINS (Union Oil Company Research Laboratory, Brea, California 92621) on a small, undetermined pelecypod that occurs abundantly in deep water Pliocene turbidites in the Ventura basin, southern California.

